

NIOSH PPT Research to Support Strategic Goal #3: Reduce Exposure to Injury Hazards

Hongwei Hsiao, Ph.D.

Chuck Kardous, M.S., P.E.

Roland Berry Ann

PPT Stakeholder Meeting

March 6, 2008



NIOSH Personal Protective Technology Program

Goal 3: Reduce Exposure to *Injury* Hazards

- *Objective 1:* Develop and evaluate warning devices for fire services.
- *Objective 2:* Develop measurement and rating methods that are representative of the real-world performance of hearing protection devices.
- *Objective 3:* Develop hearing protection laboratory and fit testing methods.
- *Objective 4:* Evaluate the effectiveness of hearing protection devices to provide protection from impulsive noise.
- *Objective 5:* Develop an integrated hearing protection and communication system.
- *Objective 6:* Develop hearing protection recommendations for noise-exposed hearing impaired workers.
- *Objective 7:* Develop and improve fall arrest harnesses.
- *Objective 8:* Select and develop vibration isolation devices to reduce hand-arm vibration syndrome.

NIOSH Personal Protective Technology Program Fall Protection

Objective 7: Develop and improve fall arrest harnesses.

- Fit and Sizing of Fall Arrest Harness
- Suspension Tolerance in a Full-body Safety Harness and a Prototype Harness Accessory

Reduce Exposure to Injury Hazards Fall Protection

Objective 7: Develop and improve fall arrest harnesses.

Hongwei Hsiao, Ph.D.
Division of Safety Research
(DSR)

A photograph of a construction site at night or in low light. A large, curved steel beam is being lifted or positioned by a crane. Scaffolding and other construction equipment are visible in the background.

Fall Protection Technology: Research and Practice

Hongwei Hsiao, Ph.D., FErgS, HonF HFES

Chief, Protective Technology Branch

National Institute for Occupational Safety and Health



WORKPLACE SAFETY AND HEALTH



Outline

Problem and protection criteria

Influential culture factors

NIOSH research and practice

Emerging issues



WORKPLACE SAFETY AND HEALTH



Problem and protection criteria (1/3)

651 fall fatalities and 86,900 injuries each year



Construction



Warehouse



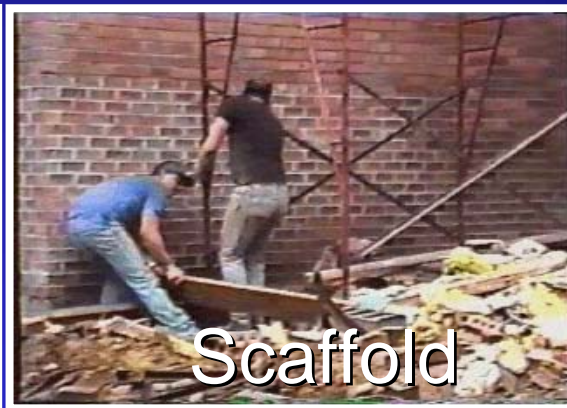
Service



Roof



Ladder



Scaffold

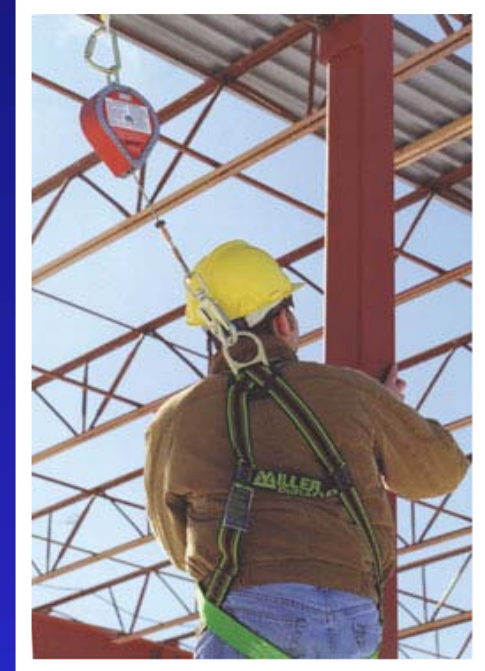
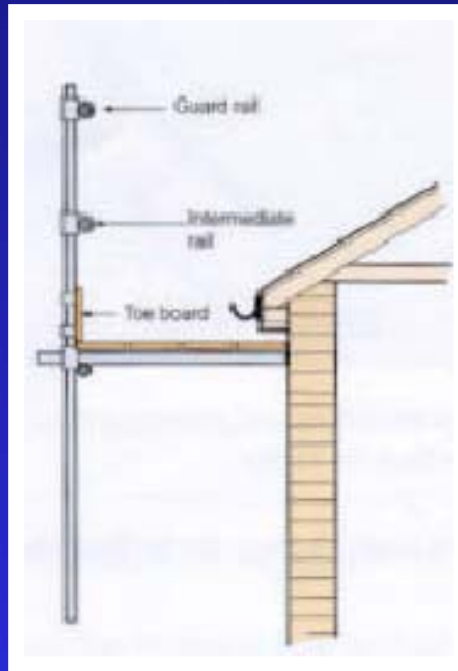


WORKPLACE SAFETY AND HEALTH



Problem and protection criteria (2/3)

OSHA Regulations (Standards - 29 CFR) 1926.502 Fall protection systems criteria and practices



Problem and protection criteria (3/3)



Influential “culture” factors (1/2)

- Construction cultural values
 - *acceptance of risk as a part of business*
- Economic cost of technology
 - *tasks are done in a short period of time*
- Manufacturer’s liability on safety technologies
 - *reluctance to take lead to commercialization*
- Standards and regulations process
 - *long process to set and implement*



Influential “culture” factors (2/2)

- Large number of small businesses
 - *limited safety resources*
- Challenges in field (and lab) research
 - *risk to subjects and researchers*
- Product design and technology transfer
 - *significant time and cost to process*
- Injury Data Systems
 - *do not correspond to safety interventions*



Case 1: NIOSH research and practice (1/2)

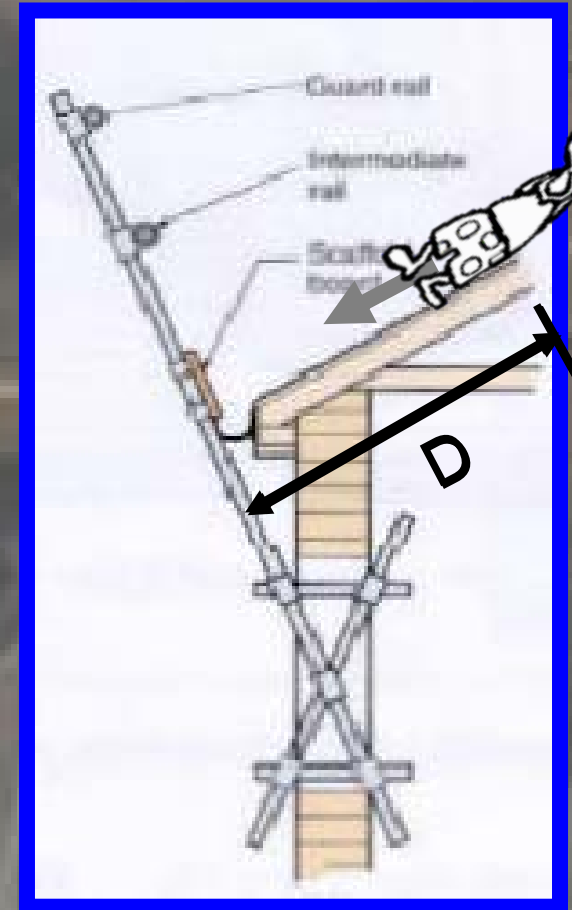
Normal Force (NF)
= Mass x g x Sin 45°

Sliding Force =
Mass x g x Cos 45°

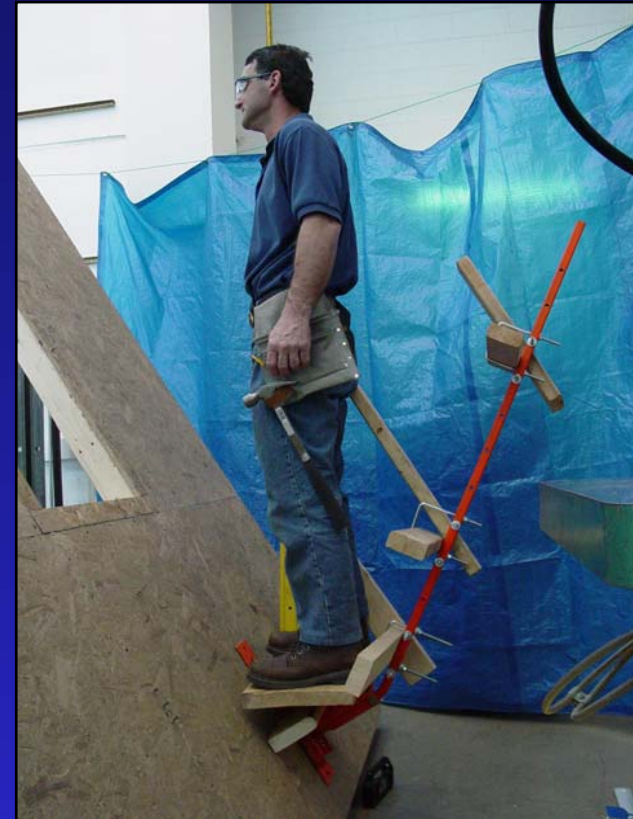
Friction Force
= $\mu_r \times NF$
= $\mu_r \times \text{Mass} \times g \times \sin 45^\circ$

Mass x g

45°



Case 1: NIOSH research and practice (2/2)



**Roof Pitch Range:
6/12 (27°) to 24/12 (63°)**



WORKPLACE SAFETY AND HEALTH



Case 2: NIOSH research and practice (1/3)



Fall-arrest harnesses provide the last line of defense to 5 million construction workers in areas where fall-from-height hazards cannot be completely eliminated.



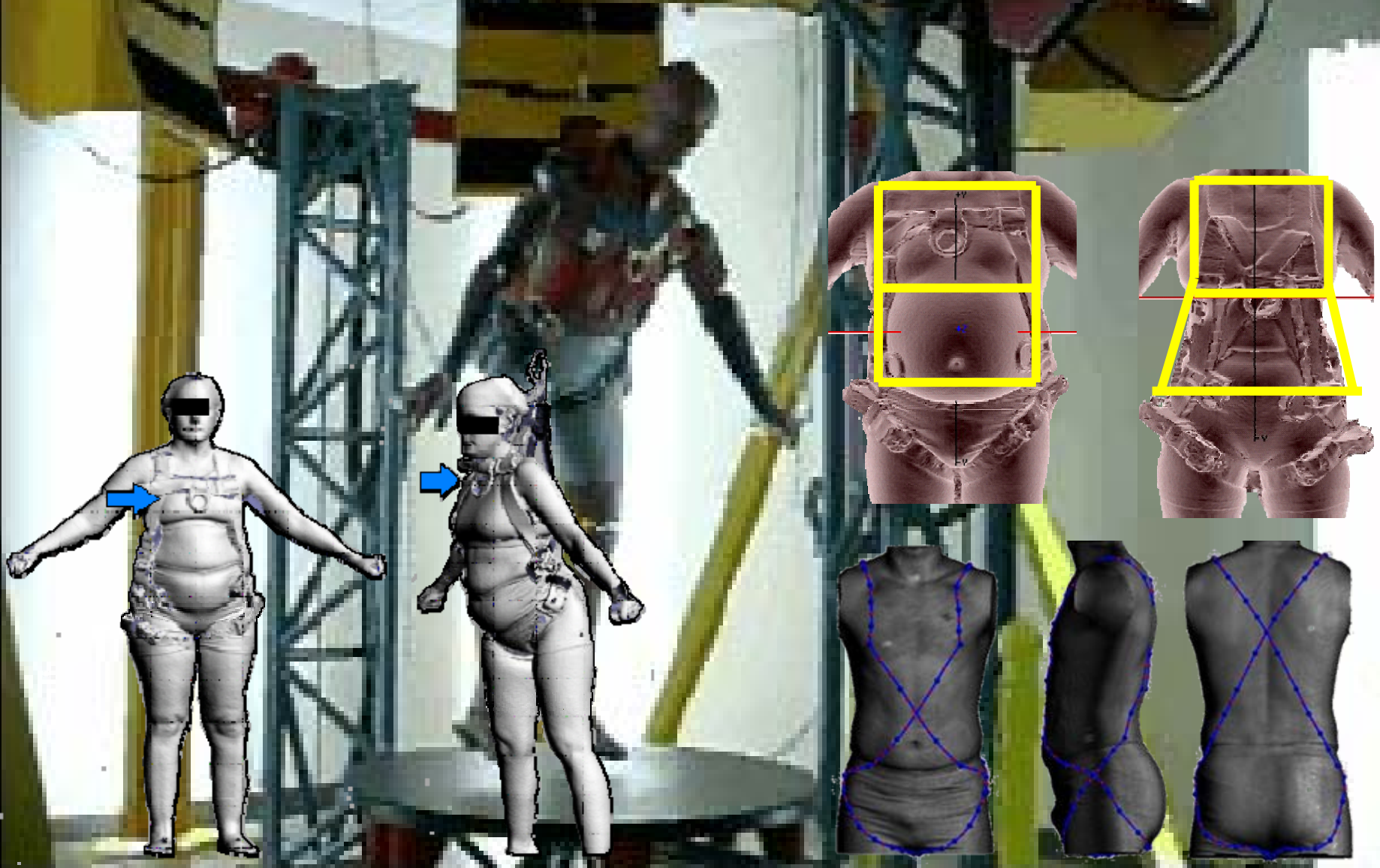
Current sizing for harnesses is based on body measurements of military personnel taken during 1970s and 1980s.



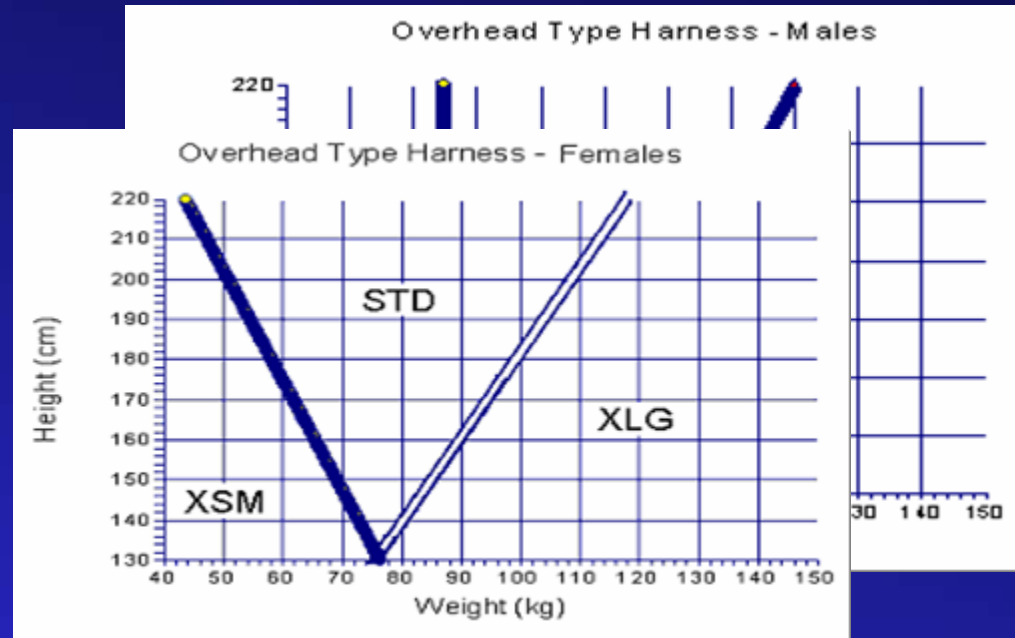
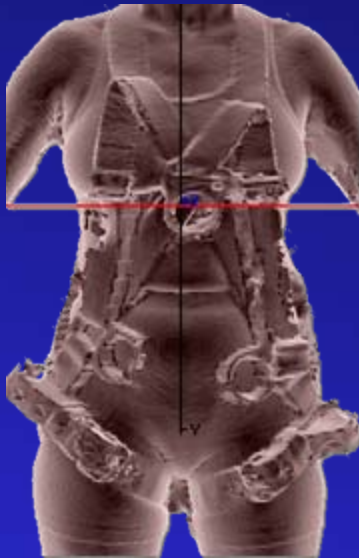
WORKPLACE SAFETY AND HEALTH



Case 2: NIOSH research and practice (2/3)



Case 2: NIOSH research and practice (3/3)



Commercialization: Two leading harness manufacturers in the U.S., MSA and DBI-SALA, are using the research results to modify their current harness designs as well as to develop the next-generation harnesses.

Case 3: NIOSH research and practice (1/2)

Construction workers are at risk of suspension trauma (insufficient blood flow to the heart) if they are not rescued in 5~30 minutes after a successful arrested fall by a harness.



Case 3: NIOSH research and practice (2/2)

A harness attachment developed by NIOSH holds the upper legs in an up-right position after a fall, which helps blood flow to the heart preventing the onset of suspension trauma symptoms. The suspension trauma relief strap will deploy even if a worker is unconscious.



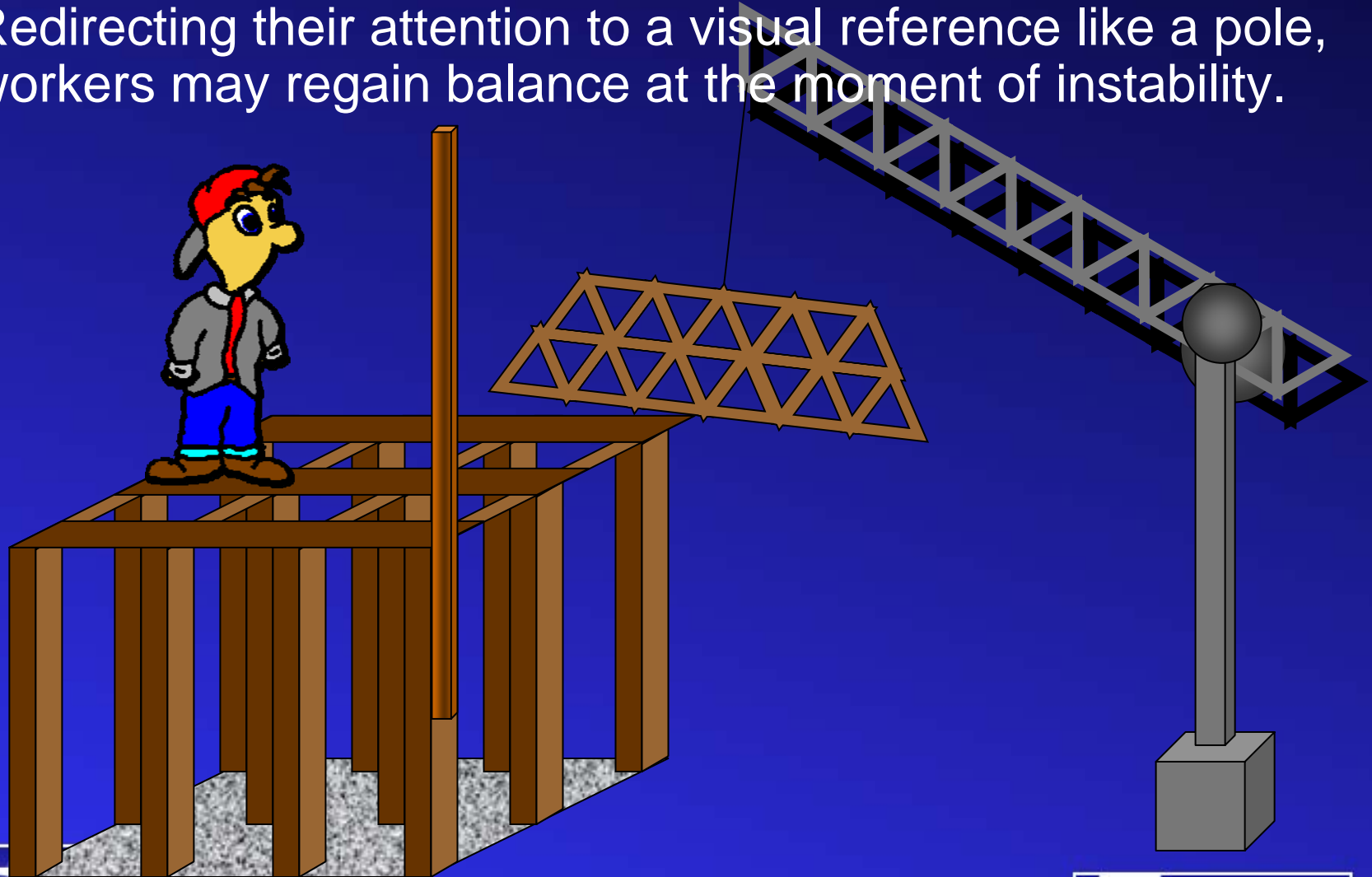
Case 4: NIOSH research and practice (1/2)

Most falls occur because of loss of balance. By learning why falls can occur in the virtual environment, engineers can find ways to keep workers safe in reality.



Case 4: NIOSH research and practice (1/2)

Redirecting their attention to a visual reference like a pole, workers may regain balance at the moment of instability.



Emerging issues (1/5)

Demographic changes

- Aging workforce
- Diverse workforce
- Increasing body size and body shapes
- Increasing residential construction
- High fall fatality rate of Hispanic workers



Emerging issues (2/5)

Technology changes

- Wireless fall-exposure assessment tools
- Biomarkers to understand underlying fall mechanisms
- Digital virtual reality technology
- Energy absorbing materials or technology



Emerging issues (3/5)



V-17183
Telesteps
12½' Aluminum
Telescoping
Ladder

RETAIL VALUE
\$299.00

QVC PRICE
~~\$242.00~~

INTRODUCTORY
PRICE
\$219.96

S&H \$12.47

QVC 1-800-345-1515
www.QVC.com

EASY PAY
4 PAYMENTS OF
\$54.99

www.officeclips.com

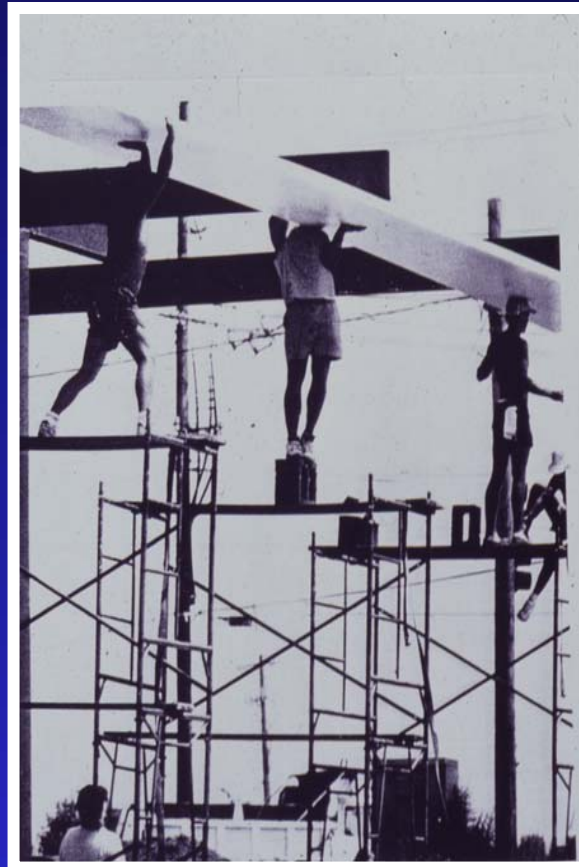
The advertisement features a background image of a man in a blue shirt and hat standing on a yellow telescoping ladder against a building with a large circular window. The ladder is extended to the second floor.



WORKPLACE SAFETY AND HEALTH



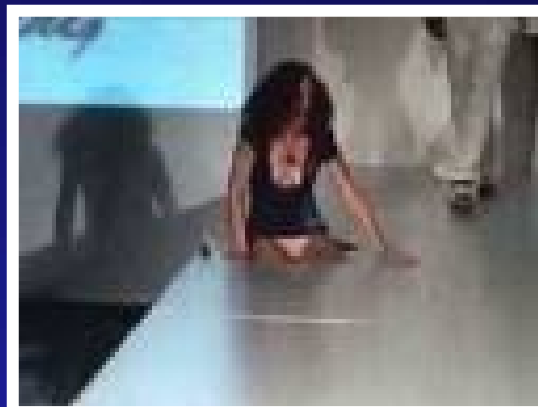
Emerging issues (4/5)



WORKPLACE SAFETY AND HEALTH



Emerging issues (5/5)



Partnership and technology transfer are essential in injury prevention practice for cost effectiveness and better outreach reasons

DISCLAIMER

The findings in this presentation are those of the author and do not necessarily represent the views of the National Institute for Occupational Safety and Health (NIOSH)

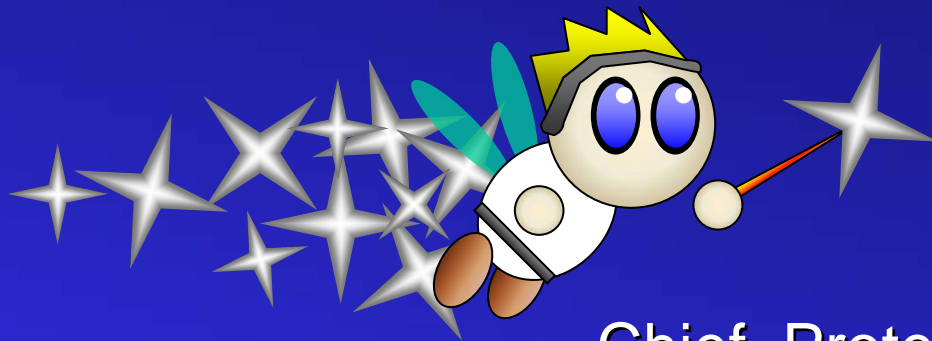
Mention of any product in this presentation does not constitute an endorsement of the product by NIOSH or the author



WORKPLACE SAFETY AND HEALTH



Questions?



Contact:

Hongwei Hsiao, Ph.D.

Chief, Protective Technology Branch

National Institute for Occupational Safety and Health

hxh4@cdc.gov



WORKPLACE SAFETY AND HEALTH



NIOSH Personal Protective Technology Program Hearing Protection

Objective 2: Develop measurement and rating methods that are representative of the real-world performance of hearing protection devices.

Objective 3: Develop hearing protection laboratory and fit testing methods.

Objective 4: Evaluate the effectiveness of hearing protection devices to provide protection from impulsive noise.

Objective 5: Develop an integrated hearing protection and communication system.

Objective 6: Develop hearing protection recommendations for noise-exposed hearing impaired workers.

- Hearing Protection Devices: Current Research at PRL
- Motivating and Empowering Use of Hearing Protection Devices

Reduce Exposure to Injury Hazards Hearing Protection

Objective 2: Develop measurement and rating methods that are representative of the real-world performance of hearing protection devices.

Objective 3: Develop hearing protection laboratory and fit testing methods.

Objective 4: Evaluate the effectiveness of hearing protection devices to provide protection from impulsive noise.

Objective 5: Develop an integrated hearing protection and communication system.

Objective 6: Develop hearing protection recommendations for noise-exposed hearing impaired workers.

Chuck Kardous, M.S., P.E.

Division of Applied Research and Technology
(DART)

Hearing Protection Research

Chucri Kardous and William Murphy
Hearing Loss Prevention Team- Cincinnati

R.J. Matetic and Robert Randolph
Hearing Loss Prevention Branch - Pittsburgh

The results reported in this paper represent the opinions of the authors and are not representative of the policies of the National Institute for Occupational Safety and Health.



WORKPLACE SAFETY AND HEALTH

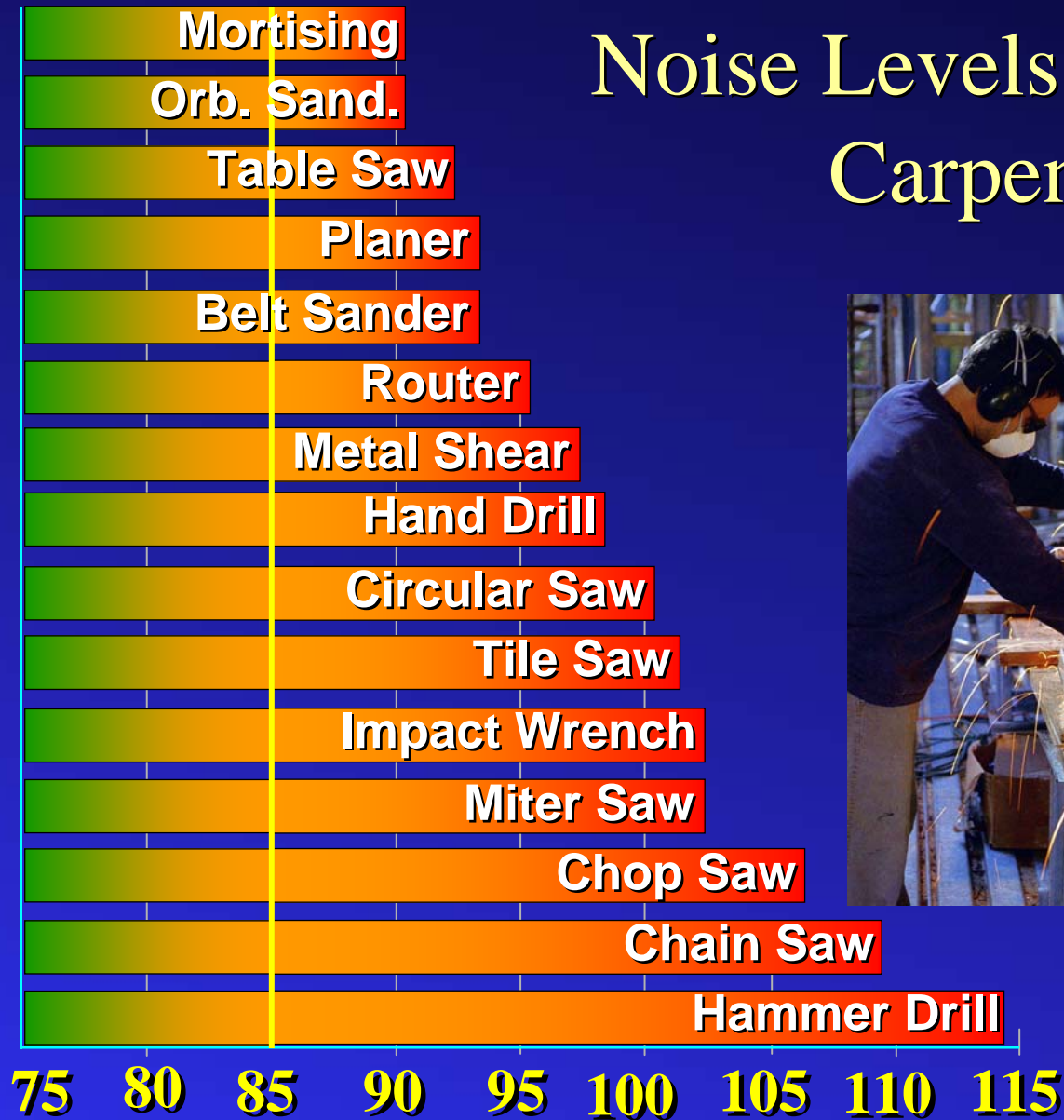


How big is the problem?

- Noise-induced hearing loss (NIHL) is the most common occupational illness in manufacturing
- 30 million people exposed occupationally
- 10 million people have NIHL
- Hearing loss accounts for about 10% of non-fatal recordable occupational illnesses

Noise Levels for Carpentry

Task/Tool



HEARING LOSS PREVENTION

Mission Statement

- Provide national and world leadership to reduce the prevalence of occupational hearing loss through a focused program of research and prevention.

Hearing Loss Prevention Strategic Goals

1. Improve surveillance
2. Reduce of noise emission levels from equipment
3. Develop hearing protector technology
4. Develop evidence-based best practices for hearing loss prevention program
5. Identify hearing loss risk factors through epidemiologic research

Hearing Protection Strategic Goal

- To Reduce Hearing Loss through Interventions Targeting Personal Protective Equipment

Hearing Protection Considerations

- Engineering noise control not feasible or difficult to implement
- Worker safety and ability to communicate
- Level of noise attenuation
- Comfort
- New technology

Selecting Hearing Protection

- Consider
 - ◆ Attenuation
 - ◆ Comfort
 - ◆ Convenience
 - ◆ Cost
 - ◆ Communication
- Types of Protection
 - ◆ Ear Muffs
 - ◆ Ear Plugs
 - ◆ Semi-aural Inserts
 - ◆ Specialized protectors

Ear Muffs

- Advantages
 - ◆ Easy to Fit
 - ◆ Good for Intermittent Use
- Disadvantage
 - ◆ May be uncomfortable
 - Heat
 - Long-time
 - ◆ May be incompatible with other equipment



Ear Plugs



- Advantages
 - ◆ Cooler to wear
 - ◆ Compatible with other safety equipment
- Disadvantages
 - ◆ Individual variability
 - ◆ Can work loose
 - ◆ Clean hands

Sound Restoration



Communication Headset



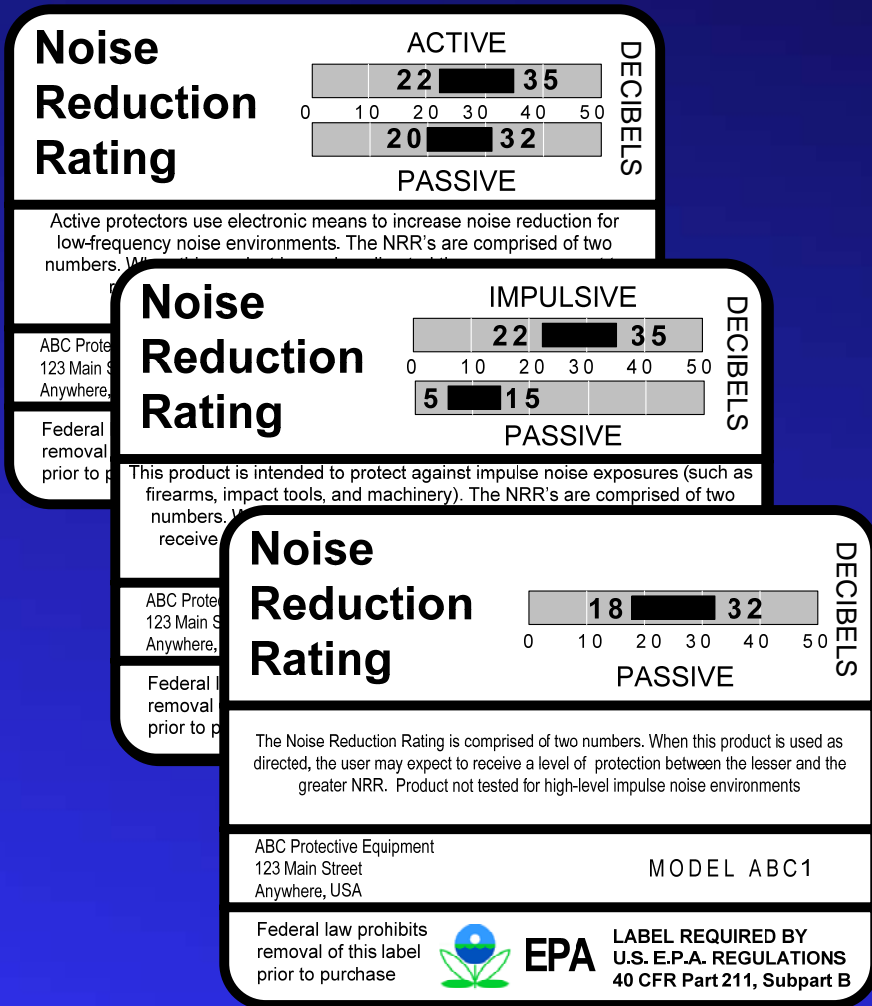
Nonlinear Orifice



Current Research

- Develop measurements and rating methods that are representative of real-world performance
- Develop hearing protection fit-testing methods
- Effectiveness of HPD against impulse noise
- Hearing Protection and Communication
- Develop recommendations for hearing protection for hearing-impaired workers

Hearing Protector Products



- NIOSH is providing EPA technical advice for revision of the HPD labeling regulation 40 CFR 211 Subpart B.

- ANSI S12.6-2008 Trained-User Fit will be used to measure the passive attenuation of all HPDs

- ANSI S12.68-2007 will be used to calculate the Noise Reduction Rating for HPDs.

- Rating performance for impulsive and active hearing protection

Hearing Protection Products



- HPDLab: Real Ear Attenuation Testing (REAT) according to ANSI standards

NIOSH Laboratory – Cincinnati

NIOSH Laboratory – Pittsburgh

Howard Leight Industries

U.S. Army

NASA – Developing HPDLab v.3

- MultiFit: REAT testing under headphones for multiple subjects

NIOSH Laboratory – Pittsburgh

Hearing Protection Products

Hearing Protection Compendium


<http://www.cdc.gov/niosh/topics/noise/hpcomp.html>

NIOSH - Hearing Protector Device Compendium Search - Mozilla

File Edit View Go Bookmarks Tools Window Help

http://www2a.cdc.gov/hp-devices/hp_srchpg01.asp Search

Home Bookmarks Motley Fool My Excite Stepwise Quest Technol... NuVox CDC MACCS SEICHE Memb... ebay NeXT

 **HEARING PROTECTOR DEVICE**
COMPENDIUM

[How to Use the Search Engine](#)

[How Loud is your Workplace](#)

[Methods for Calculating and Using Reduction Ratings](#)

[Links to Manufacturers](#)

[Browse the Database](#)

[Information for Hunters and Shooters](#)

[General Information and Disclaimer](#)

Product Type: Manufacturer:

if you want to search on a certain NRR

Product Type: Manufacturer: NRR:

if you want to search on a selected Noise Level

Product Type: Manufacturer: Noise Level: dBA (Enter data in left box)

☐ Octave Band Level (Enter data below)

125	250	500	1000	2000	4000	8000
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Done

Start Microsoft... Inbox... CY2003 Docum... New Tit... NIOSH... SigmaPl... Jasc Pa... 4:16 PM

Reduce Exposure to Injury Hazards Warning Devices for Fire Service

Objective 1: Develop and evaluate warning devices for fire services.

Roland Berry Ann
**National Personal Protective
Technology Laboratory
(NPPTL)**

SG 3: Reduce Exposure to Injury Hazards

Obj 1: Develop and Evaluate Warning Devices for Fire Services

Issue

- Warning devices should incorporate technical advances to minimize firefighter risk to injury or fatality when becoming lost or trapped in a fire situation to facilitate their rescue.
- Limitations identified in Personal Alert Safety Systems (PASS) in FFFIPP investigation

Key Partners

National Fire Protection Association (NFPA)
National Institute of Standards and Technology (NIST)
Carnegie Mellon University (CMU)

International Association of Fire Fighters (IAFF)
International Association of Fire Chiefs (IAFC)
RAND Corporation
Safety Equipment Institute (SEI)

Approach (FY01 – FY06)

- Focus group findings and guidance documents from disasters used as inputs to set research priorities
- Need for a firefighter locator device identified
- Collaborative effort to develop a personal location device
- Monitoring efforts to develop a firefighter location system for collaboration opportunities
- NPPTL issued “systems safety” contract in 2003
- A NIOSH OEP grant in 2004 was to develop a Bioelectronic Telemetry System For Fire Fighter Safety
- FFFIPP notification to NFPA initiated research on PASS system performance at fire scene environments at elevated temperatures

Evaluations

- 2005 peer review of development of a personal location device for emergency responders

Outputs and Transfer

- NIOSH/RAND Personal Protective Technology Conference, New York City, NY Dec 9-11, 2001
- Participated in NFPA 1982 Standard meetings, teleconferences and face to face meetings to recommend developmental testing to eliminate the potential for future PASS failure modes and NFPA 1982 Standard updates
- NIOSH email box to report PASS unit performance problems
- Functional Safety for Programmable Electronics Used in PPE: Best Practice Recommendations (In Nine Parts) 9/2007

Outcomes

- NFPA alert, "PASS alarm signals can fail at high temperatures"
- SEI email box to report PASS unit performance problems
- NFPA 1982 Standard on Personal Alert Safety Systems (PASS), 2007 Edition, Dec 2006

Next Steps

- Continue participation in NFPA Electronic Safety Equipment Technical Committee meetings to support future revisions to NFPA 1982 PASS standard
- Support development of performance requirements for “wireless” PASS warning systems to warn a base station outside the fire scene of a firefighter in distress
- Evaluate possible collaboration in research into technologies to permit monitoring of firefighter location and physiological status such as heart rate, skin and internal body temperatures to warn of impending health hazards
- Develop compact instrumentation that accurately characterizes firefighter thermal loading

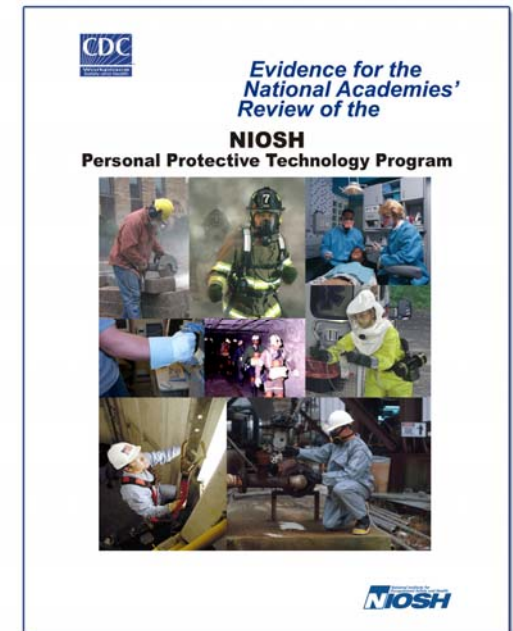
NIOSH Personal Protective Technology Program Poster Exhibits and Displays

Goal 1: Reduce Exposure to ***Inhalation*** Hazards

Goal 2: Reduce Exposure to ***Dermal*** Hazards

Goal 3: Reduce Exposure to ***Injury*** Hazards

- Fire Fighter Glove Sizing
- Protective Eyewear
- Fit and Sizing of Fall Arrest Harness
- Suspension Tolerance in a Full-body Safety Harness and a Prototype Harness Accessory
- Hearing Protection Devices: Current Research at PRL
- Motivating and Empowering Use of Hearing Protection Devices



Quality Partnerships Enhance Worker Safety & Health



Visit Us at: <http://www.cdc.gov/niosh/programs/ppt/>

<http://www.cdc.gov/niosh/npptl>

Disclaimer:

The findings and conclusions in this presentation have not been formally disseminated by the National Institute for Occupational Safety and Health and should not be construed to represent any agency determination or policy.

Thank you